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ABSTRACT

Academic employment patterns of women and men scientists in eight disciplines were studied. The primary data source was the National Science Foundation's (NSF) annual surveys of "Scientific and Engineering Personnel Employed at Universities and Colleges." Data were also obtained from site visits from a representative sample of nine of the total 50 leading doctorate-granting institutions included in the study. It was found that a greater percentage of women are employed in large and in prestigious institutions. Women are being employed in the top-ranked departments in the 50 leading doctorate-granting universities, a finding which implies a significant gain in status for women in academe. However, the positions that these women occupy could not be identified from the NSF data. Women were the most prominent in psychology, comprising 25 percent of the employees, and least prominent in engineering, comprising only three percent of the employees. Women continue to be concentrated in the life sciences, the social sciences, and psychology: they continue to be least visible in the technical disciplines such as engineering and the physical sciences. Women scientists were found to be concentrated in the very-largest institutions: women in the social sciences were almost equally represented in small and large schools. Many women scientists were found to be in nontenured research positions. (SW)

DISTRIBUTION OF WOMEN SCIENTISTS:

THE NUMBERS ARE MISLEADING

The academic employment patterns of women and men scientists differ across fields and in status.

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In recent years great strides have been made toward increasing the participation of women scientists in the academic community. The number of women receiving baccalaureate degrees has doubled in the past ten years, and currently women account for 49 percent of the total undergraduate enrollment in the United States (1). On the graduate level, the percentage of women receiving doctorates in the sciences rose from 7 percent in 1965 to nearly 17 percent in 1976 (2). Yet the number of women scientists employed in colleges and universities has not changed comparably. The proportion of women scientists employed full-time in academic institutions has increased only 1 percentage point, from 15 to 16 percent, since 1974 (3).

Do these figures reflect real differences in the opportunities available to women scientists in academic settings? Does the slight overall increase mask large increases in the number of women in some fields and decreases in others? What is the relative status of the academic positions held by these women as compared to men scientists?

The present article addresses these questions and identifies the differences in the employment patterns of women and men scientists in eight different disciplines. This represents a departure from previous studies of academic women, which either focus on women in only one field, or neglect to present comparable data for men (4). By examining several fields, overall employment patterns are identifiable

and can be justifiably generalized to women scientists as a diverse group.

Data Sources

There were two sources of data. The primary source was the National Science Foundation's annual surveys of Scientific and Engineering Personnel Employed at Universities and Colleges (5). In 1976, this survey included data from 2,300 institutions, including two-year colleges, which offered degree credit courses in the sciences and engineering. We examined women's employment in the 50 leading doctorate granting institutions, which were defined as those reporting the largest numbers of full-time scientist and engineer employees. These 50 schools employed 47 percent of all women scientists in the 1976 survey.

In reporting to NSF, academic institutions include research assistants, postdoctorals and other non-scientific staff along with faculty members in their employee count. These counts are tabulated separately for each of eight scientific fields defined by NSF: engineering, physical science, environmental science, mathematical science, life science, medical science, social science and psychology.

A second source of data was site visits to a representative sample of nine of the 50 institutions. The case study institutions were selected to provide diversity with respect to geographic location, urban versus rural environment, institutional size, source of support (public or private),

and the proportion of women scientists employed. The nine selected schools were: University of Arizona; Harvard University; Louisiana State University, Baton Rouge; University of Michigan; Northwestern University; Purdue University; University of Southern California; Texas A &·M University; University of Washington. At each institution, deans, department chairs, faculty, research staff and students in the various scientific fields were interviewed regarding the numbers, status and experiences of women scientists. These interviews enabled us to explore the dynamics underlying the numbers and thus interpret the statistical trends observed in the NSF data.

Distribution of Women Scientists

The total employee count in all fields in our sample of 50 schools was approximately 77,000, of which 16.4 percent were women. The proportion of women varies a great deal across fields, as can be seen from the first column of Table 1 (6). Women are the most prominent in psychology, comprising 25 percent of the employees, and least prominent in engineering, comprising only 3 percent of the employees. Overall, the distributions of women across the various disciplines reflect the traditional career interests of women in the sciences, and as such are representative of findings from other studies. Women continue to be concentrated in the life sciences, the social sciences and psychology; they continue to be least visible in the technical disciplines such as engineering and

the physical sciences.

Contrary to the literature on women academics generally (7), we found women scientists to be concentrated in the very largest institutions. We categorized the 50 sample schools according to size based on the total number of scientists and engineers employed full-time. Seventeen institutions with a full-time scientist and engineer population of over 1,650 were classified as large; 15 institutions with a scientific employee population between 1,251 and 1,649 were classified as medium, and 18 colleges with a scientific employee population of less than 1,250 were classified as small.

In large schools, women constituted 18 percent of the total employee count, while in small schools women constituted 14 percent of the total. The right columns of Table 1 show the percentage of women employees in the eight scientific fields. This pattern held consistently in six of the eight fields, the two exceptions being the life sciences and the social sciences.

In the social sciences, women were almost equally represented in small and large schools, accounting for 21 percent of the employee force in small schools and 20 percent in the large schools. This distribution may be a function of the differences in the work activities of social scientists as compared to those in other scientific fields. A college or university would be less likely to hire a sociologist or economist as a

pure researcher than a physicist or chemist. Rather, most social scientists are required to teach in addition to doing research. Thus the pattern for the social sciences is consistent: women social scientists are most likely employed in smaller schools in greater numbers as instructional staff.

Another significant pattern was a concentration of women employees in high prestige departments. This finding is in keeping with a recent study by Cartter and Ruhther (8) of the prestige level of the first job placement of women doctorates. Using the American Council on Education report, A Rating of Graduate Programs, prepared by Roose and Anderson (9), they divided institutions into five levels of prestige. The Roose-Anderson rankings themselves were compiled from the subjective ratings of the quality of graduate programs given by faculty and administrators in various fields. Cartter and Ruhther found approximately 20 percent of women doctorates were being placed in the top three categories of schools, as compared to 16 percent of the men. These percentages do not mean, however, that women were getting more jobs in prestige schools. Rather, the steady decline of job opportunities in academe during the early seventies hit men more severely, while women continued to be hired at the same rate as in past years, presumably because of affirmative action programs.

Our analyses also indicated that women were being employed in the top-ranked institutions in large numbers. Using the Roose-Anderson scheme, we categorized departments rather than

institutions in five fields according to a three-level prestige ranking. The fields for which we were able to derive ranking schemes were engineering, physical science, mathematics, life science, psychology and social science.

Table 2 (10) shows the percentage of women and men employees in five fields at each level of prestige ranking. Across all fields, the percentage of women employees in high quality departments is greater than the percentage of men. In the case of engineering, a field which has just recently begun to show strong increases in the number of entering women, the differences in the distributions of men and women across the different quality rankings is striking. In engineering, almost 88 percent of the women were in top-ranked departments as compared to 57 percent of the men. In the physical sciences, 65 percent of the women compared to 53 percent of the men were in top-ranked departments.

The concentration of women in high quality departments in engineering and the physical sciences seems even more striking when these distributions are compared to the distributions of men and women in psychology and the social sciences. Within the study sample, women were generally found in small proportions in engineering, where they accounted for 3 percent of all employees, and the physical sciences, where they accounted for 6 percent of the total. In psychology and the social sciences, however, they were relatively well represented, accounting for 25 percent of

the employees in psychology and 19 percent of those in the social sciences. In examining the distributions of women across the different quality rankings of departments in these fields, the distribution of women was found not to differ greatly from the distribution of men. In psychology the distributions are identical, while in the social sciences 50 percent of the women are found in the top-ranked departments compared to 51 percent of the men. It appears, then, that as the number of women increases within a discipline, their distribution across different quality schools grows more similar to the distribution of men.

If faculty and administrators in top quality departments have a large pool of women to evaluate along with men, they can distinguish differences in ability and productivity. The result is a similar distribution of men and women across different levels of departments, as found in the social sciences and psychology. But in a field such as engineering, where there is only a small proportion of women, highly rated departments seem to have an advantage in recruiting both graduate students and employees, as evidenced by the concentration of women engineers in the top level programs. It should also be noted that in disciplines where the pool of women is small, women tend to be outstanding in performance and ability. As more women enter a field, the population becomes more representative of all ability levels. Thus, as the number of women in engineering increases, the concentration

should diminish, and women engineers in academe should become more evenly distributed across the different prestige levels of programs.

Status of Women Scientists

Past research on women in higher education indicates that academic women have been clustered in the lower faculty ranks. In Ladd and Lipsett's 1976 study of faculty (11), women were found to hold 41 percent of the instructor positions, 40 percent of the lectureships and 29 percent of the assistant professor positions, but only 17 percent of the associate professorships and 10 percent of the full professorships. Their study did not, however, include non-faculty women.

While the National Science Foundation surveys do provide an indicator of the science resources in colleges and universities, they mask the reality of women scientists' positions in the academic community. The headcounts and simple percentages include women who are senior faculty at prestigious research schools as well as women with baccalaureate degrees who are research assistants in university laboratories. Our site visits to the nine institutions revealed that the numbers alone are quite misleading.

The case study institutions were a representative sample of the 50 institutions that comprised the study sample. The distribution of women scientists in the various disciplines

in the site visit schools matched the distribution found in the sample of 50 institutions. Women were most prominent in psychology (21.9 percent) and the life sciences (20.1 percent), and least well represented in engineering (2.2 percent), and the environmental sciences (4.6 percent). The range for individual school means of the percent of women employed was also similar to that found in the larger sample -- with a low of 3.2 percent to a high of 20.3 percent. The percentage of women employed within the site visit schools was 15.5 percent, slightly less than the 16.4 percent found for women in the total sample.

We discovered that large numbers of women reported as full-time scientists or engineers on the NSF surveys, and for compliance with HEW requirements, hold off-ladder, non-tenured research scientist appointments, most often funded by extramural grants rather than general University funds. Many of these women have to find their own grants in order to receive a salary. For a few women, a research position was a voluntary and satisfactory choice, but for many it was a forced and unwelcome compromise. Many married doctorates were unable to obtain regular faculty positions because of institutional nepotism customs which, in practice, discriminate against women. Other women had received their doctorates at the institution where their husbands were employed, subsequently finding themselves ineligible for faculty ladder positions because of the "we never hire our own" policy. Like nepotism

practices, this policy protects an institution from losing its vitality and becoming sterile through inbreeding. Inherently not discriminating, in practice it severely discriminates against women, and the consequences are exceptionally severe when the university is in an isolated area with limited or no alternatives for employment at other postsecondary institutions or in industry.

While research scientist positions can be valuable experiences for women who are beginning their professional careers, these positions do not carry the status or salary of regular faculty appointments. Along with other "adjunct" or "acting" positions, research scientists are for the most part a disenfranchised, second-class faculty whose grant moneys contribute overhead to the institution. Denied the right to vote or even attend faculty meetings, they are responsible for serving on committees, teaching courses and supervising doctoral students. More importantly, these positions hinder professional development if they are held for a long period of time. Rarely are tenured faculty appointments made from among an institution's lecturers or research scientists, and seldom are these people recruited by other universities, particularly if they have held this type of appointment for more than a few years.

Unfortunately, the prospects for a dramatic change in the status of women scientists in the near future are slight, despite the increasing numbers of women entering scientific

fields. Women are entering the system and coming up for promotion just as retrenchment and tight budgets are reducing the number of faculty positions. Instead of hiring new Ph.D.s in tenure track positions, more and more colleges are turning to limited-term, contract appointments to bring in new blood and maintain departmental vitality. In most institutions, the term of appointment is three years; in a few, it is six years. In all cases, the positions are terminated and there is little or no chance of being retained on a permanent faculty status. Again, although this practice is not inherently discriminatory and applies equally to men as well as women, the consequences are that it severely limits the advancement of women in the academic world at a time when they are being encouraged to enter it.

In spite of the conditions of employment, however, we did find the atmosphere to be noticeably different at institutions which had a relatively high percentage of women scientists. Department chairmen (12) at institutions with few women were quick to describe their recruiting procedures as a search for "the best qualified candidate". "We'd love to hire a qualified woman, but we won't beat the bushes to look for her" was a frequent statement. But at institutions where there were comparatively more women scientists, deans and department chairmen added to the "best qualified" statement a consideration of women's more limited opportunities heretofore. These deans and department chairmen were willing

to use whatever means of affirmative actions necessary, in the truest sense of the words, even if these means were non-traditional.

Summary and Conclusions

Analysis of the academic employment patterns of both women and men scientists and engineers revealed that a greater percentage of women are employed in large, and in prestigious institutions. Women are being employed in the top-ranked departments in the 50 leading doctoral-granting universities, a finding which implies a significant gain in status for women in academe. However, the positions that these women occupy could not be identified from the NSF data.

The purpose of the NSF surveys is to monitor the supply of scientific manpower resources in the United States. These surveys mask the dismal reality of women scientists' positions in academe. The headcounts and simple percentages do not reveal their ranks, salaries or job status, and the site visits confirmed that these numbers are grossly misleading. The absolute numbers of women scientists and engineers may be increasing in some cases, but the percentages are small and women are still found in the lower ranks and untenured positions. In fact, we found that a disproportionate number of the women scientists reported as full-time employees on the NSF surveys were in reality in non-tenured research positions. These appointments were especially common in

the scientific fields.

Based on the findings of this study, we believe that women scientists in academe are in a period of transition. The human rights movement of the sixties expanded women's awareness of the alternative roles available to them, and the increasing numbers of women that have pursued graduate education in the sciences in recent years have no doubt been influenced by the spirit of these times. Making promised opportunities a reality for women in the sciences, however, will require both time and concerted effort on the part of institutional administrators, government policy-makers, and women scientists themselves. Women are still a small minority in the scientific community, without much power or prestige. To a great extent, their position is the result of economic forces and cannot be attributed to overt discrimination on the part of individuals or institutions. Yet, certain administrative policies and a simple lack of awareness on the part of many male faculty and administrators have also served to limit women's advancement.

Overall, affirmative action is working, but to a limited degree. Women scientists and engineers are being allowed entrance to academe. In the site visit institutions, women academics generally were receiveing a somewhat larger share of the new hires because of affirmative action. But the door is rotating and they exit almost immediately, as most of these new positions are short-term and the chances of becoming

part of the tenured faculty are slim.

Department chairs, university administrators and federal policy-makers should consider focusing less on the numbers of women scientists employed or the numbers of women graduate students enrolled and more on who and where in the system these people are. Otherwise, the status of women in academe will not change.

REFERENCES AND NOTES

1. Chronicle of Higher Educ., (Jan. 9, 1978).

2. National Science Board. Science Indicators, 1976. (Government Printing Office, Washington, D.C., 1976).

3. National Science Foundation. Manpower Resources for Scientific Activities at Universities and Colleges: Detailed Statistical Tables Appendix B. (NSF 77-321, 1977).

4. For studies focusing only on women scientists and engineers, see, for example, T. Conally and E. Burks, Engineering Educ., 67, 234 (1977). Most professional scientific organizations have begun to provide data on the salaries, employment and status of women and men in the particular field. See, for example, M. Berman, The Professional Geographer, 29, 71 (1977); American Institute of Physics in Professional Women and Minorities: A Manpower Resource Service, B. M. Vetter and E. L. Babco, Eds. (Scientific Manpower Commission, 1975), p. 222.

5. National Science Foundation. Scientific and Engineering Personnel Employed at Universities and Colleges (FY 1974-76).

6. Chi square analyses of the distribution of women scientists were significant at the .05 level for all fields with the exception of mathematical science.

Since the chi square test is dependent upon sample size, our interpretation of the chi square values was made in the context of a careful examination of the corresponding percentage distributions of men and women resulting from the breakdown of the data by the criterion variables. The employee couhts were large, even within the various fields, and significant chi square values resulted in some cases in which comparison of the distributions of men and women showed little difference. The main focus was on the identification of general patterns or trends across fields.

7. See, for example, Carnegie Commission on Higher Education, Opportunities for Women in Higher Education (McGraw-Hill, New York, 1973), pp. 109-115.
8. A. M. Cartter and W., Ruhther, Disappearance of Sex Discrimination in the First Job Placement of New Ph.D.'s (ERIC Publication, ED 104225, 1975), p. 28.
9. K. D. Roose and B. N. Hewitt, J. Counseling Psych., 23, 1 (1976).
10. Chi-square comparisons of the distributions of women and men scientists were significant for all fields except mathematical sciences and psychology.
11. M. Ladd and S. Lipsett, Chronicle of Higher Educ., (Sept. 24, 1978).

12. The term chairmen is used purposefully, since all of those we met were men.

13. This study received the American Educational Research Association and Women Educator's 1979 Research on Women in Education Award. We thank the National Science Foundation for providing us with the financial support to conduct this study.

Table 1. Women employees as a percentage of total employee population, overall by field and within each category of faculty size, by field

Field of Specialization	Overall Percentage	Size of Employee Population		
		Small	Medium	Large
Engineering	3	1	2	5
Physical Science	6	4	6	7
Environmental Science	6	4	4	7
Mathematical Science	10	8	9	10
Social Science	19	21	16	20
Life Science	20	17	22	19
Medical Science	22	16	21	24
Psychology	25	18	28	38
All fields	16	14	17	18

Table 2. Percentage of distribution of women employees compared to distribution of men employees by prestige ranking of department, by field

Field of Specialization	Prestige Ranking		
	High	Medium	Low
Engineering			
Women	88	9	3
Men	57	29	14
Physical Science			
Women	65	22	12
Men	53	29	18
Mathematics			
Women	56	16	28
Men	55	18	28
Social Science			
Women	51	15	35
Men	46	16	38
Life Science			
Women	63	19	17
Men	57	19	23
Psychology			
Women	59	25	16
Men	59	25	15